REMARKS

Claims 1-4 were originally filed in this application. Claim 1 was previously cancelled without prejudice or disclaimer. Claims 5-13 were previously added. Claims 5, 9, and 10 are currently amended. Support for these amendments is in the specification as originally filed, specifically at paragraphs [0010]-[0013]. Claim 12 is currently cancelled without prejudice or disclaimer. As a result, claims 2-11 and 13 stand pending for examination with claims 5 and 9 being independent claims. No new matter has been added.

Rejections Under 35 U.S.C. § 103

Claims 2-11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,202,475 to Selbie et al. (hereinafter "Selbie") in view of U.S. Patent Application Publication No. 2003/0150807 A1 to Bartels et al. (hereinafter "Bartels.")

Applicants respectfully disagree that the respective subject matter of each of claims 2-11 would have been obvious over Selbie in view of Bartels.

The Disclosure of Selbie

Selbie is directed to a method of predicting logarithmic reduction values (LRV) in filtration systems by comparing a liquid flow rate through defects in a filtration membrane and a liquid flow through the membrane during filtration (Selbie at Col. 3, lines 22-24) and the use of such values for the control and monitoring of operating filtration systems. (Selbie at Col. 1, lines 6-9.) Selbie teaches a method of predicting LRV for membrane filtration systems by determining the filtrate flow rate through the membrane under the action of an applied test pressure, determining the bypass flow rate using integrity test measurements, and estimating the LRV using a ratio of the determined filtrate flow rate and the determined bypass flow rate. (Selbie at Abstract and at Col. 1, lines 30-45.) Selbie fails to disclose backwashing of a membrane.

In the Office Action, the Examiner mischaracterizes the teaching of Selbie. The Examiner asserts that Selbie discloses a method of determining flow rate through a membrane and testing the integrity of the membrane by a pressure decay method. (Office Action at page 4.) Selbie's method is further characterized in the Office Action as pressurizing the membrane lumens to a test pressure while keeping the feed-side full, sealing the filtrate side, and monitoring

the drop in pressure. (*Id.*) The Examiner alleges that "[s]ince the pressure decay is related directly to the membrane integrity, it would need to be compared 'against a predetermined value' to decide if the membrane integrity is acceptable." However, Selbie does not disclose comparing any pressure or any decay or reduction therein against any "predetermined value."

Selbie explains that by "comparing the DAF [Diffusive Air Flow] measurement with the expected value for a fully integral filter, an indication of the relative integrity of the filter can be determined." (Selbie at Col. 3, lines 3-6.) To that end, Selbie teaches comparing the liquid flow through membrane defects to liquid flow through the membrane during filtration, i.e., without defects. (See Selbie at Col. 3, lines 18 *et seq.*) Notably, Selbie explains that utilizing a liquid advantageously simplifies the testing process because it is incompressible and "none of the considerations of pressure as needed for the air flow, [sic] need to be considered." (Selbie at Col. 4, line 66 *et seq.*) Indeed, Selbie further provides that LRV can be predicted from the bypass flow rate by comparison with the filtrate flow rate according to equation (18). (Selbie at Col. 6, lines 15 *et seq.*)

Clearly Selbie does not teach that gas pressure "would need to be compared 'against a predetermined value' to decide if the membrane integrity is acceptable" as the Examiner asserts.

Further, the Examiner has not provided a citation to any section within Selbie which explicitly or implicitly teaches that the reduction in gas pressure is compared against a predetermined value.

The Disclosure of Bartels

Bartels is directed to a method of "improving performance of a filtration membrane module comprising a plurality of microporous hollow fibers, the method comprising subjecting the fibers to gas-assisted backwashing, wherein the gas-assisted back-washing removes fouling components from the fibers." (Bartels at paragraph [0029].) In the filtration module disclosed in Bartels, feed liquid is introduced to the lumen side of fiber membranes. Filtrate is directed through the membranes and collected into a hollow pipe for removal from the module. (Bartels at FIG. 1 and paragraph [0038].)

Bartels discloses a method including acts of forward flushing, bottom "backwashing," top "backwashing," soaking, and rinsing. (Bartels at paragraphs [0031]-[0036].) However, the term "backwashing" as used in Bartels is not used in its conventionally understood manner. As

defined by the Examiner on page 2 of the Office Action, and as used in the present application (see, e.g., paragraphs [0010]-[0013] of the present application), backwashing is "a method of reversing the normal direction of flow through a membrane to dislodge anything which may have become entrapped during filtration, it is understood that the backwashing process is conducted in the opposite direction [of filtration]." Bartels does not disclose a process of backwashing consistent with this conventionally understood definition because any flow of liquid through the membrane of Bartels is disclosed as flowing from the feed side to the filtrate side, which is in a same direction as fluid flow during filtration, not in an "opposite direction [of filtration]."

"Bottom backwashing" as described in Bartels involves simultaneously closing the top feed line of the membrane module while opening the bottom feed line of the module. A liquid is then transferred from the filtrate reservoir through the hollow fiber membrane, into the lumen, and finally to a waste disposal drain. (Bartels at paragraph [0043].) "Top backwashing" as described in Bartels involves simultaneously closing the bottom feed line of the membrane module while opening the top feed line of the module. A liquid (e.g., water) is then transferred from the filtrate reservoir through the hollow fiber membrane, into the lumen, and finally to a waste disposal drain. (Bartels at paragraph [0044].) Neither of these steps involve backwashing of a membrane as backwashing is defined by the Examiner and used in the present application.

Gas pressurization can be carried out before either forward flushing, bottom backwashing, or rinsing. Gas pressurization is accomplished by draining the bottom lumen side of the hollow fibers while simultaneously introducing gas (e.g., air) into the top lumen side of the fibers. (Bartels at paragraph [0047].) In the gas pressurization step, Bartels relies on the application of gas pressure to the lumens of fiber membranes to expand the membranes in order to "assist[] in dislodging fouling components." (Bartels at paragraph [0047].) Bartels also relies on a "[r]apid release of the gas pressure" to "provide[] additional force for dislodging fouling components." (*Id.*)

While applying the gas pressure to the membrane fibers according to the method disclosed by Bartels, the membrane fibers are exposed to gas on both the lumen side and the external side. In paragraph [0047], Bartels states "the gas pressurization should not persist long enough to dry the membrane." Because the gas pressurization pushes feed out of the lumens of the membranes, thereby drying them as soon as the gas fills the membrane lumen, the only other part of the membranes that might dry over time are the external walls or the pores. The only way

the external walls or the pores might dry is if they were exposed to a gaseous, rather than a liquid environment.

The Examiner mischaracterizes the teaching of Bartels. As discussed above, the Examiner defines backwashing as involving a flow from a filtrate side to a feed side of the membrane, in a reverse direction from that of filtration. The Examiner characterizes Figure 9 and paragraph [0048] of Bartels as describing "a method of backwashing by introducing a gas pressure below the bubble point on the lumen side of the membrane." The Examiner concludes that "[a]s the membrane is to be backwashed, the permeate within the lumens is pushed back through the membrane by the gas pressure." However, in Bartels, the lumens are the feed side of the membranes, and thus a step where "permeate within the lumens is pushed back through the membrane by the gas pressure" involves pushing liquid through the membrane in the same direction as a flow of liquid during filtration. Thus, this step cannot be considered backwashing as defined by the Examiner and as the term backwashing is used in the present application.

Bartels gas pressurization step cannot be a step of backwashing. Bartels explains that the "gas-assisted backwash" procedure involves introducing a gas on the lumen side (the feed side) of the hollow fiber membrane, rather than the filtrate side. (Bartels at paragraph [0047].) Clearly, Bartels does not teach backwashing with a gas applied at the filtrate side of the membrane and, instead, teaches displacing water from the feed side through the membrane. (Bartels at paragraph [0048].) This is not a method of "reversing the normal direction of flow through a membrane to dislodge anything which may have become entrapped during filtration . . . in the opposite direction and subsequent to the filtering of a liquid suspension." Thus, by the Examiner's own definition of "backwashing" Bartels fails to teach a method of backwashing.

Further, one of ordinary skill in the art would not consider the method disclosed in Bartels to be a method of backwashing because the method of Bartels would further embed any particulates retained on the wall of the lumen after filtering feed from the lumen through the membrane into pores of the membrane rather than fulfilling the conventionally understood purpose of backwashing a filtration membrane – to remove trapped particulates from the membrane pores.

Claims 2-11 Patently Distinguish over Selbie in view of Bartels

No *prima facie* case of obviousness of claims 2-11 over Selbie in view of Bartels can be made because the two references could not have been validly combined. Even if the references could have been validly combined, any alleged combination would fail to teach each and every element of any of claims 2-11.

One of ordinary skill in the art would not have been motivated to combine Selbie and Bartels in the manner suggested to arrive at the invention recited in either of independent claims 5 and 9 because the two references are directed to methods with fundamentally different modes of operation. Selbie relies on a relatively slow decrease in pressure within the membrane during membrane integrity testing. As stated in Col. 2, lines 7-12 of Selbie, "[i]f the lumens of a fully wetted membrane (i.e., all the pores are filled with liquid), are filled with air at a pressure below the bubble point, then the pores of the membrane will remain wet and there will be no significant air flow through the pores other than a relatively small flow due to diffusion." In contrast, as discussed above, Bartels relies on a "[r]apid release of the gas pressure" to "provide[] additional force for dislodging fouling components [within the lumen]." (Bartels at paragraph [0047].)

Second, as discussed above, Bartels performs gas pressurization with filtration membranes exposed on their external walls to a gaseous environment. In contrast, Selbie discloses a pressure test performed on membranes immersed in a fluid. As disclosed by Selbie, "[i]n the pressure decay test, as with the DAF test, the lumens are first pressurized with air to the test pressure keeping the feed-side of the membrane full." (Selbie at Col. 3, lines 8-10.)

Even if Selbie and Bartels could have been combined, any alleged resulting combination would fail to teach each and every element of independent claims 5 and 9. As conceded on page 4 of the Office Action, Selbie does not disclose a method of backwashing a membrane as claimed. Further, as explained above, Selbie does not teach that gas pressure, or any reduction or decay therein, is compared "against a predetermined value." Nothing in Bartels cures the defect of Selbie to teach these elements of independent claims 5 and 9. This is because nowhere does Bartels disclose any act any method of membrane integrity testing or of "backwashing [a] membrane by displacing a liquid permeate within a membrane lumen through pores of the membrane in a direction opposite that of filtration" as recited in independent claim 5 or of "displacing a liquid permeate within a membrane lumen through pores of the membrane in a direction opposite to that of a flow of liquid during filtration" as recited in independent claim 9.

One of ordinary skill in the art would not have been motivated to combine the disclosures of Selbie and Bartels for the reasons discussed above. Further, any alleged combination of these references would have lacked at least one explicitly recited claim element in each of independent claims 5 and 9. Thus, no *prima facie* case of obviousness of independent claims 5 and 9 can be made over Selbie in view of Bartels.

In addition to the above, the inventions recited in independent claims 5 sand 9 solve a long felt but unsolved need. At the time of invention of the present invention, one skilled in the art of membrane filtration technology would have appreciated that there had been a long felt, but unsolved need for avoiding the disadvantages of frequent membrane integrity testing with regard to the reduction in the production rate of a membrane filtration system while still providing for assurance that the filtration membranes were not defective. However, prior to the time of invention of the present invention no one had discovered a way to solve this need. (*See* Declaration of Warren Thomas Johnson (filed May 21, 2008) at paragraph 10.)

Accordingly, reconsideration and withdrawal of the rejection of independent claims 5 and 9 under 35 U.S.C. § 103 as being unpatentable over Selbie in view of Bartels is respectfully requested.

Dependent claims 2-4 and 6-8 depend from independent claim 5 and are patentable for at least the same reasons as independent claim 5. Dependent claims 10 and 11 depend either directly or indirectly from independent claim 9 and are patentable for at least the same reasons as independent claim 9. Accordingly, reconsideration and withdrawal of the rejection of dependent claims 2-4, 6-8, 10, and 11 under 35 U.S.C. § 103 as being unpatentable over Selbie in view of Bartels is respectfully requested.

Claims 2-11 and 13 Patently Distinguish over Selbie in view of the application background

Claims 2-13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Selbie in view of the background section of the present application.

It is noted that claim 12 has been cancelled, thus rendering the rejection of this claim moot.

Applicants respectfully disagree that the respective subject matter of each of claims 2-11 and 13 would have been obvious over Selbie in view of the application background.

There is no *prima facie* case of obviousness of claims 2-11 and 13 over Selbie in view of the application background. One of skill in the art would not have combined Selbie with the application background because the application background teaches away from the method disclosed by Selbie. Further, even if one of skill in the art would have been motivated to have combined Selbie with the application background, no alleged combination of Selbie with the application background would have taught each and every element of any of claims 2-11 and 13. For example, no combination of Selbie with the application background could have taught or rendered obvious a method of backwashing a membrane comprising applying a gas at a pressure below a bubble point of the membrane to liquid permeate within a hollow fiber membrane lumen, measuring a reduction in a gas pressure within a lumen of the membrane, and comparing the measured reduction in pressure against a predetermined value as recited in independent claim 5, or a method comprising measuring a rate of gas pressure decay within a lumen of a membrane over a predetermined period, and comparing the measured rate of gas pressure decay with a predetermined value as recited in independent claim 9.

As discussed above, Selbie fails to disclose a method comprising comparing a gas pressure against a predetermined value or any method of backwashing a membrane. Each of independent claims 5 and 9 recite methods of backwashing a membrane comprising applying a gas at a pressure below a bubble point of the membrane to liquid permeate within a hollow fiber membrane lumen. There is nothing in the application background that discloses or renders obvious backwashing a membrane comprising applying a gas at a pressure below a bubble point of the membrane to liquid permeate within a hollow fiber membrane lumen. In fact, at paragraph [0003] of the present application it is stated that "[i]n th[e] case [of gas backwashing] it is possible to empty all of the liquid within the membrane through the membrane walls leaving the membrane lumens filled with gas." All of the liquid within the membrane would not be emptied if gas was applied to the membrane lumen at a pressure below the bubble point of the membrane – liquid would remain in the membrane pores. Thus, the application background teaches away from backwashing a membrane by applying a gas at a pressure below a bubble point of a membrane to the liquid permeate within the hollow fiber membrane.

Further, nothing in the application background discloses or renders obvious a method comprising "isolating the lumen of [a] membrane, measuring a reduction in a gas pressure within [a] lumen of the membrane, and comparing the measured reduction in pressure against a

predetermined value" as recited in independent claim 5, or a method comprising "measuring a rate of gas pressure decay within [a] lumen of [a] membrane over a predetermined period, and comparing the measured rate of gas pressure decay with a predetermined value" as recited in independent claim 9. As discussed above, nowhere does Selbie disclose a method including these acts either.

Thus, there is no *prima facie* case of obviousness of independent claims 5 or 9 over Selbie in view of the application background because one of skill in the art would not have been motivated to have combined Selbie with the application background and because no alleged combination of Selbie with the application background could have disclosed each and every element recited in either of independent claims 5 or 9.

Even if a prima *facie case* of obviousness of either of independent claims 5 or 9 could have been established, it is rebutted for similar reasons directed to the alleged *prima facie* cases of obviousness of independent claims 5 and 9 over Selbie in view of Bartels as discussed above.

Accordingly, reconsideration and withdrawal of the rejection of independent claims 5 and 9 under 35 U.S.C. § 103 as being unpatentable over Selbie in view of the application background is respectfully requested.

Dependent claims 2-4, 6-8, and 13 depend from independent claim 5 and are patentable over Selbie in view of the application background for at least the same reasons as independent claim 5. Dependent claims 10 and 11 depend either directly or indirectly from independent claim 9 and are patentable over Selbie in view of the application background for at least the same reasons as independent claim 9. Accordingly, reconsideration and withdrawal of the rejection of dependent claims 2-4, 6-8, 10, 11, and 13 under 35 U.S.C. § 103 as being unpatentable over Selbie in view of the application background is respectfully requested.

CONCLUSION

In view of the foregoing Remarks, this application is in condition for allowance; a notice to this effect is respectfully requested. If the Examiner believes that this application is not in condition for allowance, the Examiner is requested to call Applicants' attorney at the telephone number listed below.

If this Response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicants hereby request any necessary extension of time. If there is a fee occasioned by this Response, including an extension fee, that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 50/2762.

Respectfully submitted,
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